US005895158A

United States Patent [19]

Koyabu et al.

[11] **Patent Number: 5,895,158**

[45] **Date of Patent: Apr. 20, 1999**

[54] **PRINTER WITH AN IMPROVED FEEDING SYSTEM**

[75] Inventors: **Akira Koyabu**; **Hiroyuki Nakayama**; **Susumu Hama**, all of Nagano-ken, Japan

[73] Assignee: **Seiko Epson Corporation**, Tokyo, Japan

[21] Appl. No.: **08/854,955**

[22] Filed: **May 13, 1997**

[30] **Foreign Application Priority Data**

May 15, 1996	[JP]	Japan	8-120664
May 15, 1996	[JP]	Japan	8-120665
May 15, 1996	[JP]	Japan	8-120666

[51] **Int. Cl.**[6] **B41J 11/48**

[52] **U.S. Cl.** **400/605**; 400/636; 400/708

[58] **Field of Search** 400/605, 607, 400/607.2, 630, 636, 636.1, 706, 707.1, 708, 595, 596, 599, 600, 600.2, 600.3

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,743,129	5/1988	Keryhuel et al.	400/596
5,000,597	3/1991	Kilb et al.	400/636
5,026,184	6/1991	Dürr et al.	400/605
5,149,217	9/1992	Narita	400/607
5,328,281	7/1994	Narita et al.	400/605

FOREIGN PATENT DOCUMENTS

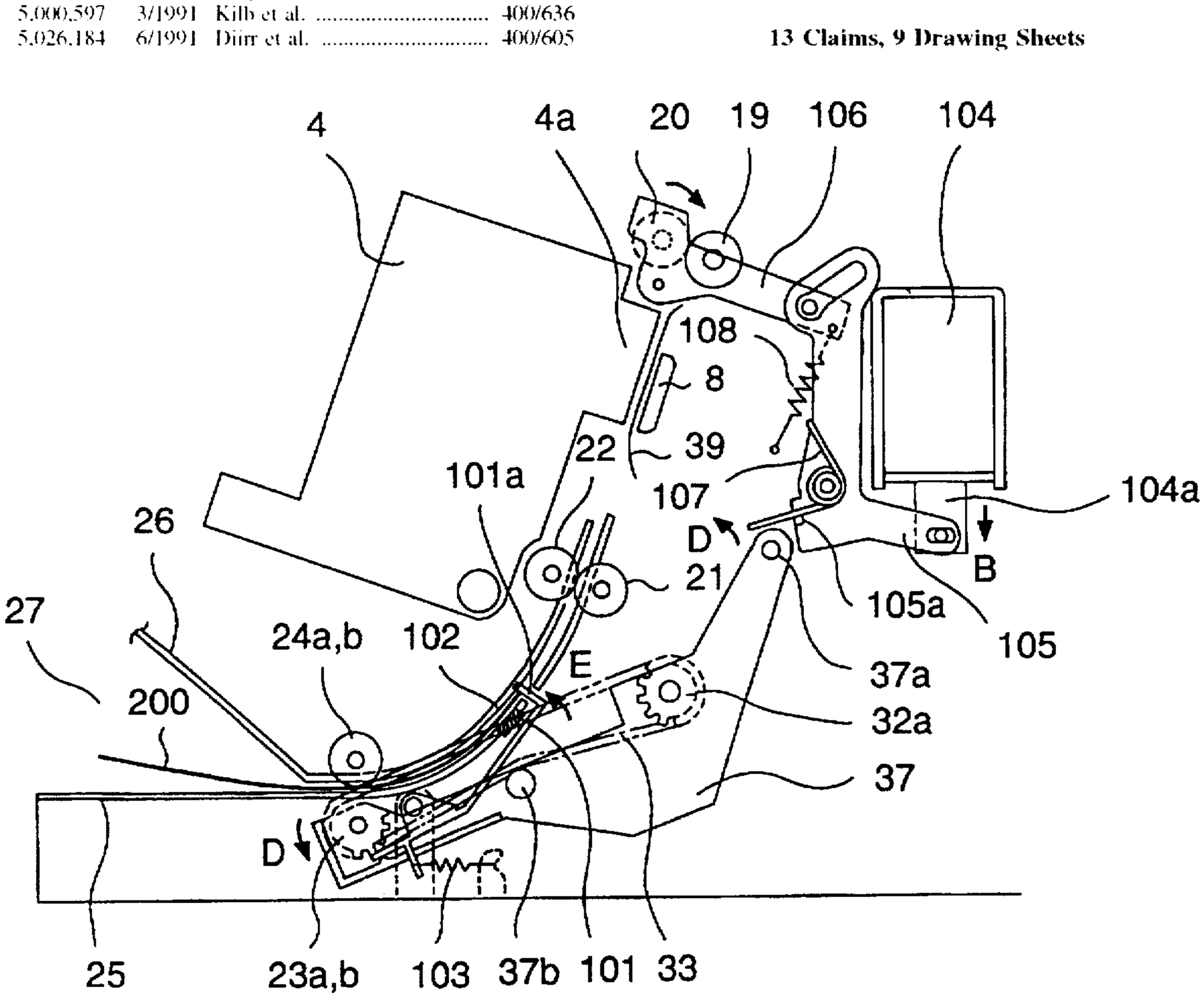
0428163	5/1991	European Pat. Off. .
0519518	12/1992	European Pat. Off. .
0530777	3/1993	European Pat. Off. .
0676295	10/1995	European Pat. Off. .
63-082262	4/1988	Japan .
63-201740	12/1988	Japan .
04191229	7/1992	Japan .
558525	3/1993	Japan .
05169671	7/1993	Japan .

Primary Examiner—Ren Yan
Attorney, Agent, or Firm—Loeb & Loeb LLP

[57] **ABSTRACT**

A printer having an ink jet type printing section for printing on a first cut sheet of paper having a first shape or a second cut sheet of paper having a second shape. A set of transfer rollers is provided adjacent to an insertion aperture for the first cut sheet of paper and mounted on one end of an open/close lever. Another set of transfer rollers is provided adjacent to a discharge aperture for the first cut sheet of paper. Opening and closing of the transfer rollers adjacent to the insertion aperture and opening and closing of the transfer rollers adjacent to the discharging aperture are performed by a common driving source.

13 Claims, 9 Drawing Sheets



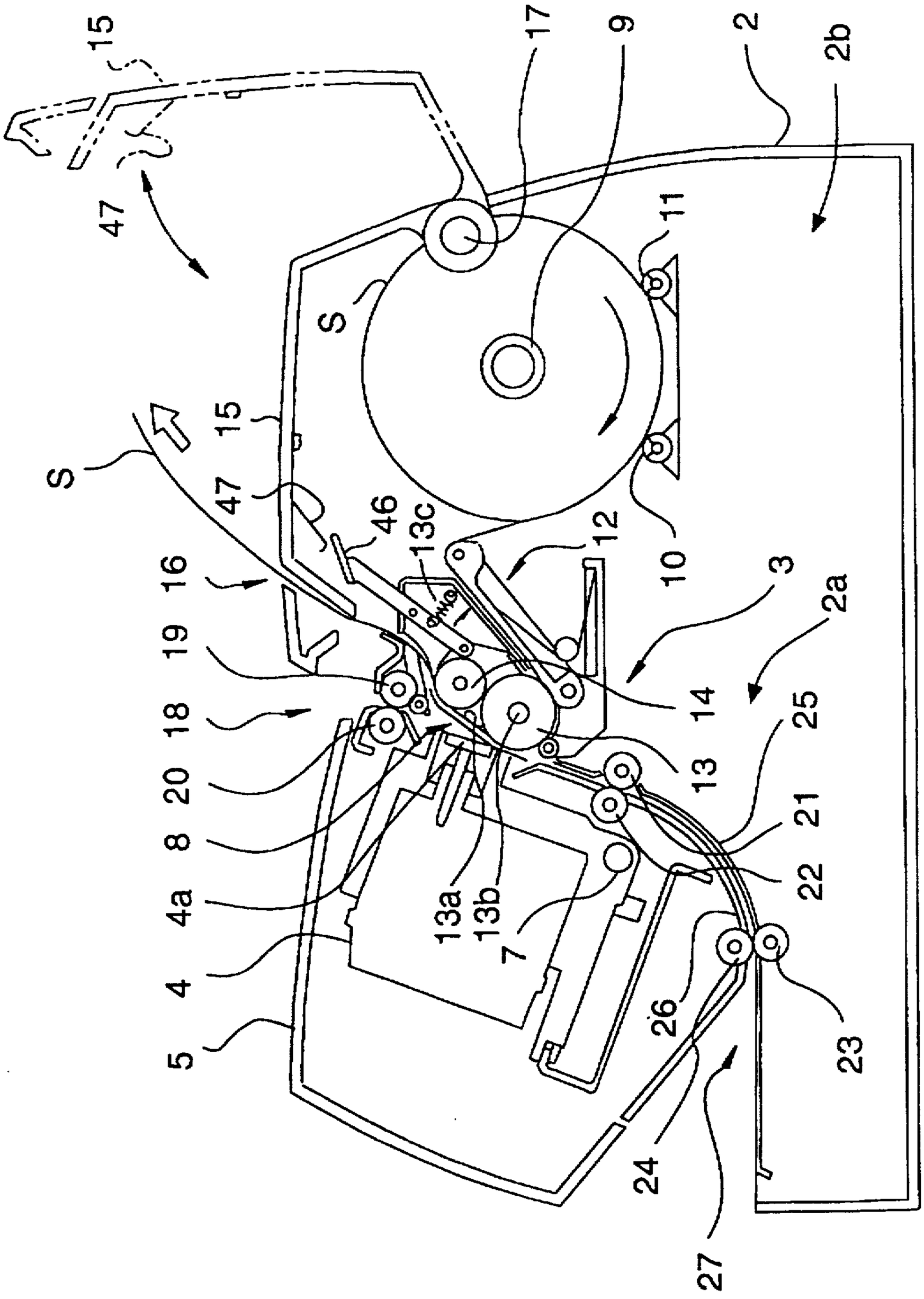

15
17
9
2
2b
47
S
11
S
15
47
46
13c
12
16
10
3
19
2a
18
14
25
20
13
21
8
22
4a
13a
13b
7
4
26
5
23
24
27
1

FIG. 1

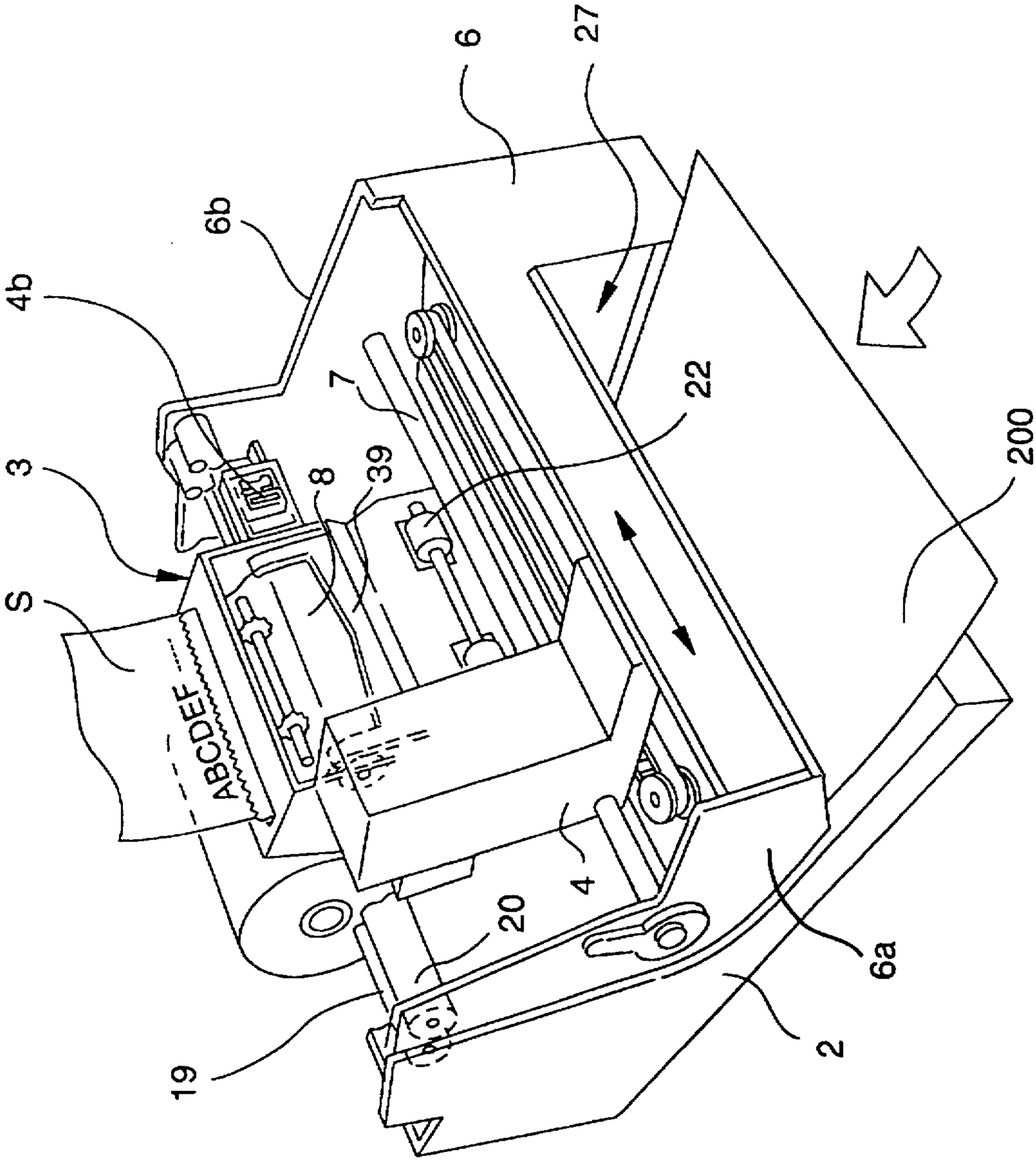


FIG. 2

3

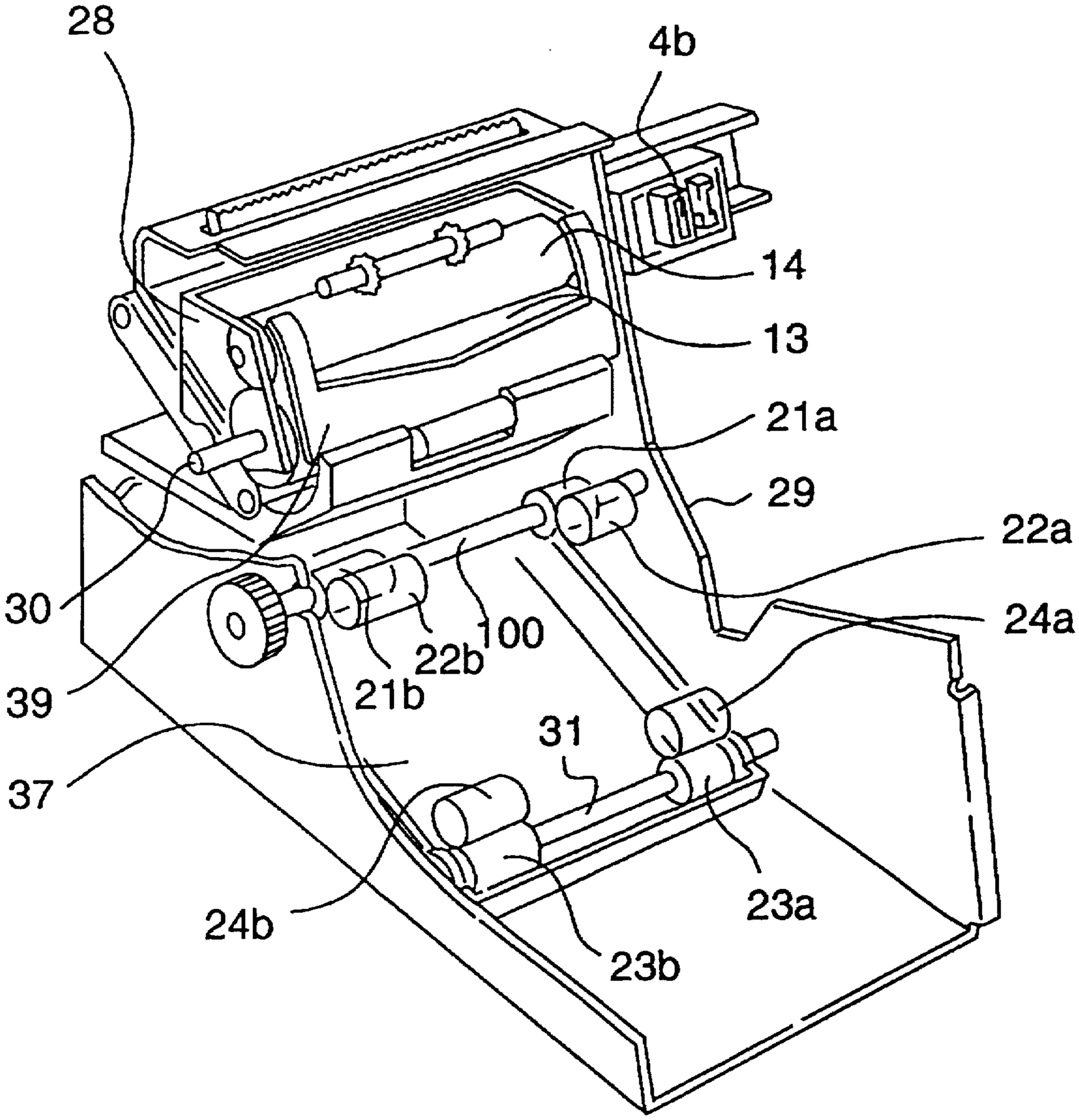


FIG. 3

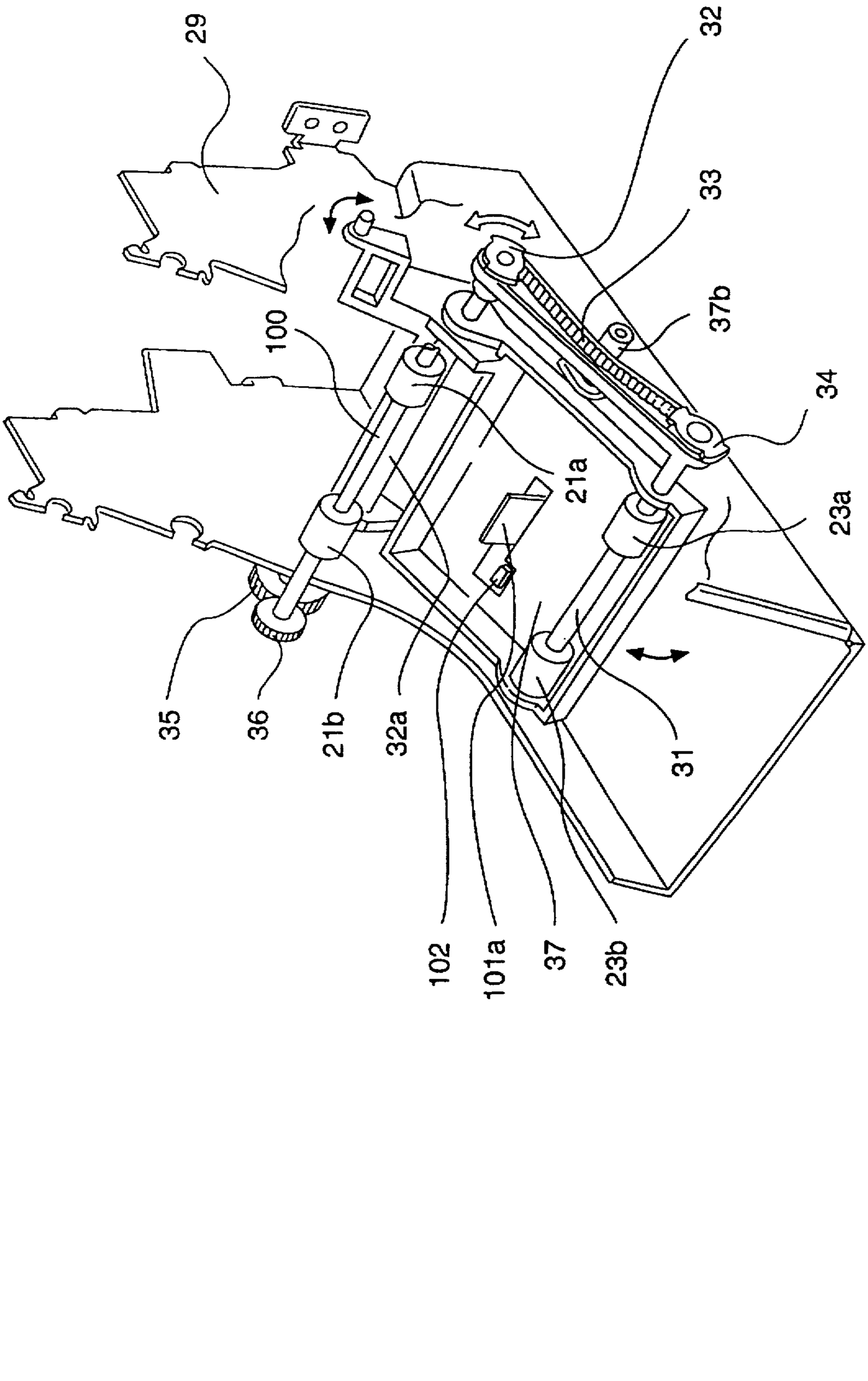


FIG. 4

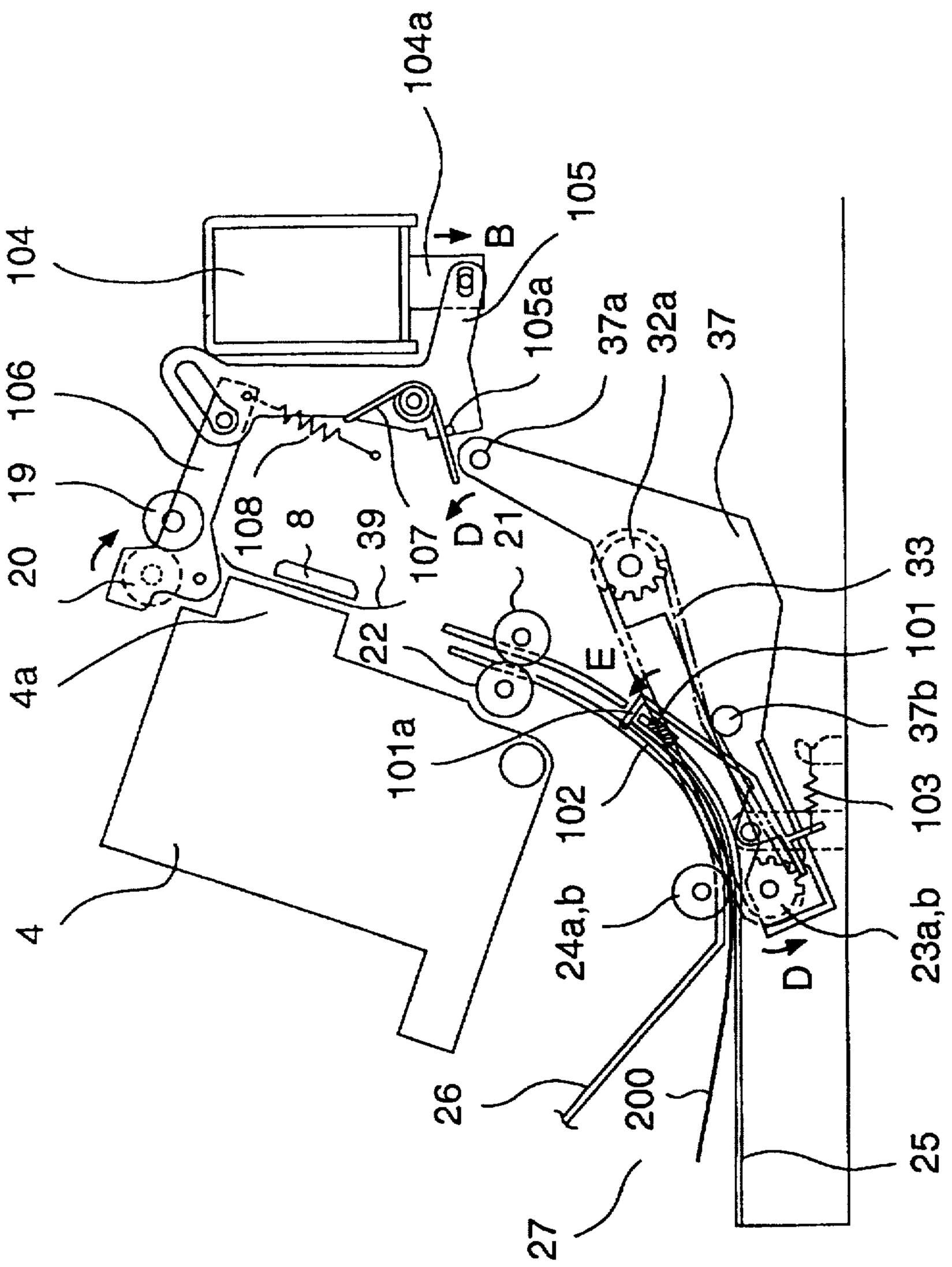

4a
104
106
19
20
108
8
39
107
22
21
105
105a
37a
32a
37
B
D
E
101a
102
24a,b
26
200
7
4
103
37b
101
33
23a,b
25

FIG. 5

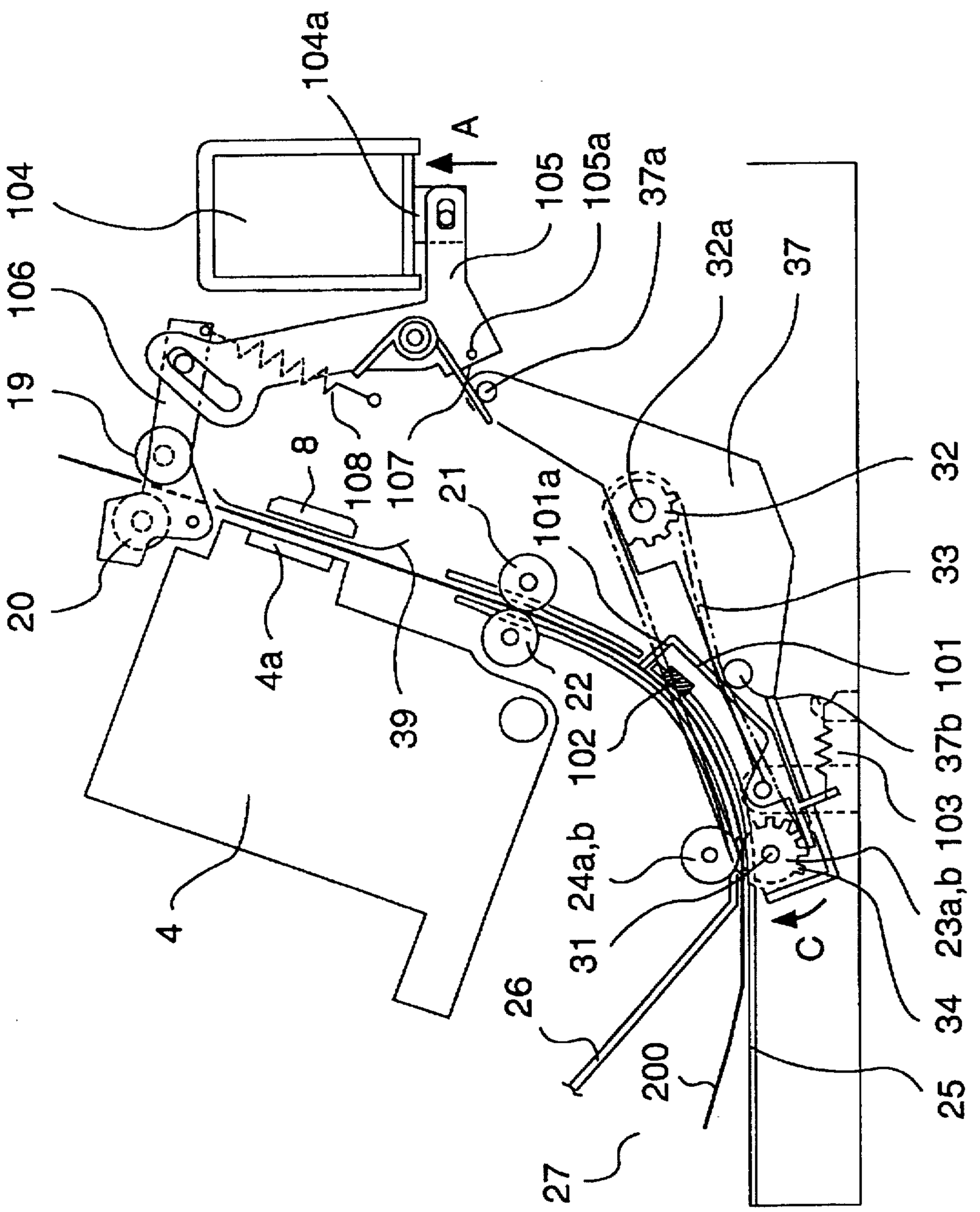

104
106
19
20
4
4a
39
8
108
107
21
101a
105
105a
37a
32a
37
32
33
102
22
24a,b
31
26
200
27
103
37b
101
34
23a,b
25
A
C

FIG. 6

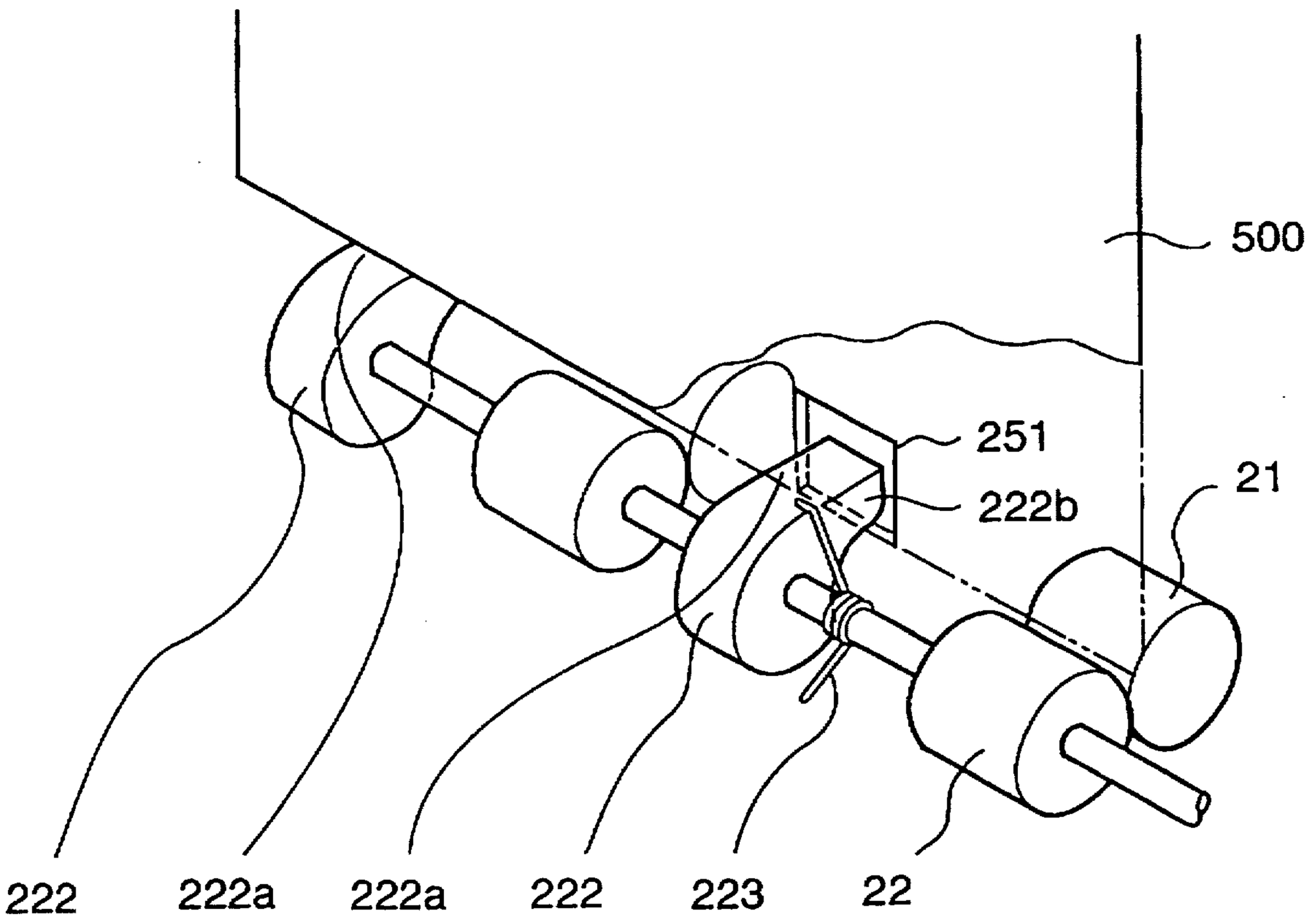


FIG. 7

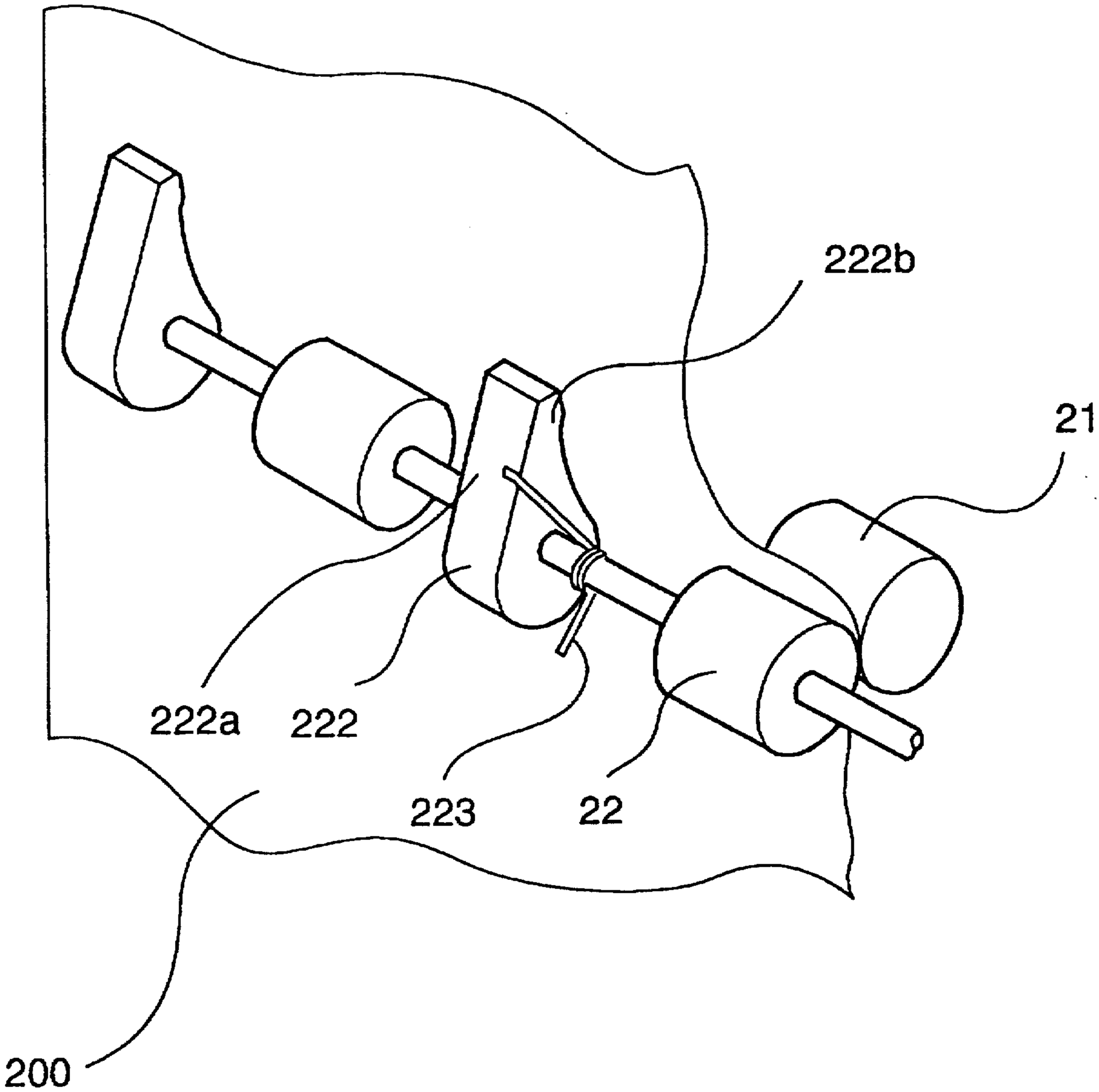


FIG. 8

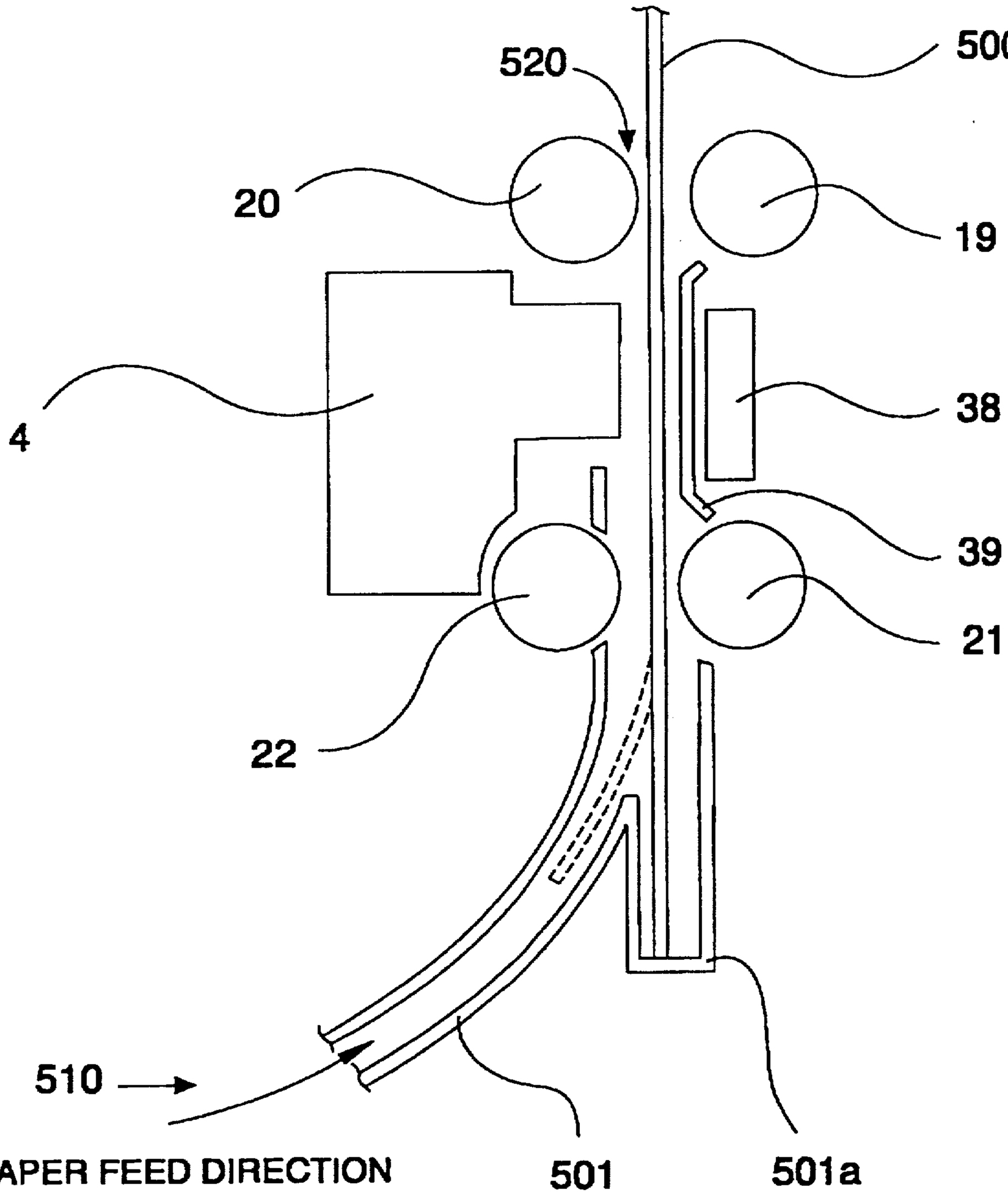


FIG. 9 (PRIOR ART)

PRINTER WITH AN IMPROVED FEEDING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a printer that handles sheets of paper, and more particularly, to a point of sale (POS) printer for printing on sheets of paper, such as, for example, paper slips, bank checks and the like.

2. Description of Related Art

A POP printer typically uses an impact dot method or an ink jet method to print on a sheet of recording paper, and may be used to print on a single sheet of paper (herein after referred to as a cut sheet of paper), such as, for example, a paper voucher, a slip, a bank check or the like. Typically, the printer has a cut-sheet feeding aperture for inserting a cut sheet of paper in the printer. The cut sheet of paper is transferred by rollers disposed adjacent to the cut-sheet feeding aperture to a printing section within the printer. The cut sheet of paper is printed at the printing section and then discharged from the printer through a discharge aperture by the operation of rollers that are disposed adjacent to the discharge aperture. Upon inserting a cut sheet of paper through the cut-sheet feeding aperture, the rollers disposed adjacent to the cut-sheet feeding aperture are separated from each other to facilitate insertion of the cut sheet of paper.

When a calculation result or the like is printed on a relatively large sheet of paper, such as a slip, (herein after referred to as slip printing), using the above-described paper feed path for transferring cut sheets of paper, the slip of paper is transferred through a paper feed path in the following manner. The slip of paper is inserted in the cut-sheet feeding aperture used for slip printing, passed through the printing section, and discharged from the discharge aperture used for slip printing.

On the other hand, the same printer may be used in a different printing operation mode. When printing five or six lines in a predetermined area on a card-shaped sheet of paper such as a bank check for payment validation (herein after referred to as validation printing), the card-shaped sheet of paper is inserted through the discharge aperture used for slip printing to the deepest section of the printing section. Then, the lines are printed on the card-shaped sheet of paper while the card-shaped sheet of paper is transferred back toward the discharge aperture.

For example, FIG. **9** shows an explanatory view of a conventional printer that is capable of validation printing. A print head **4** performs printing on a single slip of paper or a cut sheet of validation paper **500** which is transferred onto a platen **38** by a pair of transfer rollers **19** and **20** and a pair of transfer rollers **21** and **22**. The transfer rollers in each pair can open and close with respect to one another.

For printing on a slip of paper **500**, the slip of paper **500** is transferred through a slip paper feed path **501**. More specifically, the slip of paper **500** is inserted through a sheet insertion aperture **510** defined in the front surface of the printer. Then, the slip of paper **500** is guided by a paper guide **39** onto the platen **38**, printed by the print head **4** and discharged through a discharge aperture **520** defined in an upper area of the printer.

When printing on a cut sheet of validation paper **500**, the transfer rollers **19** and **20** and the intermediate transfer rollers **21** and **22** are both separated from each other as shown in FIG. **9**. After, the cut sheet of validation paper **500** is inserted into a groove section **501***a*, the transfer rollers **19** and **20** and the transfer rollers **21** and **22** are both brought into pressure contact to pinch the cut sheet of validation paper **500**. While the cut sheet of validation paper **500** is transferred upwardly toward the discharge aperture **520**, the print head **4** prints on the cut sheet of validation paper **500**.

The above-described printer suffers from the following problems.

(a) In order to insert a sheet of paper in a variety of forms in the cut paper feed path, the rollers at the insertion side are preferably separated from each other for slip printing and the rollers at the discharge side are preferably separated from each other for validation printing. In a conventional paper feed mechanism of the printer for printing cut sheets of paper, opening and closing of the rollers at the cut sheet insertion side and opening and closing of the rollers at the cut sheet discharge side are independently performed by different power sources (plungers or the like). As a result, the mechanism is complicated and independent control circuits are required for the respective power sources. Furthermore, the printer shown in FIG. **9** requires an additional mechanism for opening and closing the intermediate transfer rollers **21** and **22** in addition to the mechanism for the rollers **19** and **20** at the cut sheet paper discharge side to allow insertion of the cut sheet of validation paper **500**.

(b) In the POS printer of the type described above, a sheet of paper must be inserted in an appropriate aperture depending on the specified purpose and use. Therefore, the POS printer may have a plurality of apertures for inserting and discharging sheets of paper. In some cases, one aperture may be commonly used for inserting and discharging sheets of paper. As a result, sheets of paper can be wrongly inserted by mistake.

There is another type of POS printer that prints on a sheet of recording paper in a roll (herein after referred to as a rolled sheet of paper) for printing receipts in addition to printing on a cut sheet of paper. In this type of POS printer, a portion of the paper feed path for cut sheets of paper is used as a paper feed path for the rolled sheet of paper, and each type of paper is transferred to a common printing section. As described above, the paper feed path is formed in a manner that each different type of paper is transferred to a different discharging aperture. As a consequence, the number of apertures for inserting and discharging sheets of paper is increased, and more errors during operation and insertion are likely to occur.

(c) In general, sheets of validation paper may have a variety of different qualities. For example, there are thick, sturdy sheets of paper, thin, weak sheets of paper, copy papers formed from a plurality of laminated thin sheets of paper and the like. In order to smoothly insert and transfer a sheet of validation paper that may vary in qualities, shapes and types, a transfer path for the validation paper is preferably formed straight. In order to form a straight paper feed path, a straight groove section, such as the groove **501***a* of FIG. **9**, must be formed for positioning the bottom edge of the validation paper, as shown in FIG. **9**, in addition to the paper feed path **501** for transferring slips of paper.

When the paper feed path is formed in this manner and if the sheet of validation paper is curved, the sheet of the validation paper may not correctly enter the groove section **501***a*, and may instead enter the slip paper feed path **501** for transferring slips of paper, as shown in the broken line in FIG. **9**. If printing is started with a sheet of validation paper being set at a wrong position, then the initial position of the sheet of validation paper deviates from the designed initial position, and therefore printing may not likely be performed

at a specified location. Accordingly, a mechanism for preventing such a problem may be additionally required, and thus the paper feed system and the control of the paper feed system become more complicated.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a printer with a simple structure that correctly guides sheets of paper of a variety of different types.

It is another object of embodiments of the present invention to provide a printer that handles sheets of paper of a variety of types and that is capable of opening and closing the sheet transfer rollers for transferring cut sheets of paper by a single source of power. As a result, insertion of sheets of paper of a variety of types is facilitated and error insertion of sheets of paper of a variety of types is substantially prevented.

In accordance with one embodiment of the present invention, a printer for printing on a sheet of paper includes at least a pair of first transfer rollers disposed in a sheet insertion side and a pair of second transfer rollers disposed in a sheet discharging side. Open/close operation of the first transfer rollers and open/close operation of the second transfer rollers are associated with one another and performed by a single driving source. As a result, a plurality of rollers can be opened and closed by a single driving source, and thus the open/close mechanism and the open/close control are simplified.

In accordance with another embodiment of the present invention, the printer includes a link movement mechanism for maintaining the second transfer rollers in a closed state when the first transfer rollers are placed in an open state by the driving source, and maintaining the first transfer rollers in a closed state when the second transfer rollers are placed in an open state. The printer has a discharge aperture that is commonly used as an aperture for discharging a sheet of paper for slip printing and an insertion aperture for inserting a sheet of paper for validation printing. By this structure, for example, when performing slip printing, only the first rollers at the sheet insertion side are separated from each other so that a sheet of paper for slip printing can be inserted. At this moment, the second rollers, that are disposed adjacent to the discharge aperture, are maintained in a closed state. As a result, a sheet of paper for validation printing is not inserted in the printer by mistake. On the other hand, when performing validation printing, the first rollers are closed and the second rollers are separated from each other, and thus a sheet of paper for slip printing is not inserted in the printer by mistake.

In accordance with another embodiment of the present invention, the printer has third rollers disposed intermediate to the first rollers and the second rollers and a printing section for printing on the sheet of paper disposed intermediate to the second rollers and the third rollers. By disposing the third rollers at the above-described location, the following paper transfer operation is achieved. After a sheet of paper for slip printing is inserted, the first rollers are closed and the sheet of paper is transferred by the first rollers. When the sheet of paper reaches the third rollers, the sheet of paper can be transferred by the third rollers. When the sheet of paper is further transferred and reaches the second rollers, the first rollers are opened and the second rollers are closed so that the sheet of paper can be transferred by the second rollers. In other words, when the cut sheet of paper is longer than both the distance between the first rollers and the third rollers and the distance between the second rollers and the third rollers, the cut sheet of paper can be transferred through the paper feeding path. Further, if the above condition is met, then the entire surface of a very short sheet (cut sheet) of paper can be printed. Moreover, the number of rollers that simultaneously pinch and drive the sheet of paper is always two pairs or less. Therefore, problems in feeding sheets of paper are substantially eliminated. For example, wrinkles that may be formed in a sheet of paper by pinching the sheet of paper by too many rollers do not likely occur, and thus the sheet of paper is securely transferred.

In accordance with another embodiment of the present invention, the printer can selectively print on a sheet of paper that is inserted in an area on the side of the first rollers and on a card-shaped sheet of paper that is inserted in an area on the side of second rollers to an area adjacent to the third rollers. The printer has a common aperture disposed adjacent to the second rollers for discharging the sheet of paper and for inserting the card-shaped sheet of paper. As a result, the common aperture commonly serves as a discharge aperture for slip printing and an insertion aperture for validation printing. Accordingly, the structure of the printer is simplified.

In accordance with another embodiment of the present invention, the printer includes a form stopper for positioning a leading end of the sheet of paper inserted from the side of the first rollers. The form stopper is capable of projecting into and receding from a paper feeding path. The projecting and receding operation of the form stopper is performed in association with the open/close operation of the first rollers by a single driving source. In other words, the operation of the form stopper to position the sheet of paper is associated with the open/close operation of the rollers, and these operations are performed by the single driving source. Accordingly, the structure is further simplified.

In accordance with one embodiment of the present invention, the printer includes a paper feed path for transferring a sheet of paper that is provided in a roll, and a common printing section for printing on a cut sheet of paper as well as on a sheet of paper in a roll.

In the printer having the structure described above, the first rollers are maintained in an open state and the second rollers are maintained in a closed state when printing on the sheet of paper in a roll. As a result, while the second rollers are closed and the first rollers are opened upon printing on the sheet of paper in a roll, the form stopper is protruded and thus a cut sheet of paper cannot be inserted in the printing section. In this manner, when printing on a sheet of paper in a roll, the paper feed path for cut sheets of paper is closed on the side of the first rollers and on the side of the second rollers. Accordingly, a cut sheet of paper cannot be inserted by mistake.

Further, in the printer having the structure described above in accordance with one embodiment of the present invention, one of the pair of the first transfer rollers and the pair of the second transfer rollers have a fixed-side roller supported by a frame and a shifting-side roller supported by a lever that is rotatably mounted on the frame. The shifting-side roller comes in contact with and separates from the fixed-side roller in association with the rotational movement of the lever. A drive pulley is preferably mounted at a pivot point of the lever, and the drive pulley and the shifting-side roller are coupled by a belt under a tension so that driving force is transferred from the drive pulley to the shifting-side roller through the belt. As a result, when the lever that supports the transfer roller is rotated, the distance between the pivot point of the transfer roller and the pivot point of the

driving pulley does not change so that the tension of the belt connecting the transfer roller and the driving pulley remains constant. Accordingly, the driving force is securely transferred to the transfer roller, and each cut sheet of paper is transferred at a precise designed sheet transfer pitch. A tension adjusting pulley is preferably mounted on the lever for adjusting the tension of the belt. Since the pulley moves together with the lever, when the tension of the belt is adjusted, the adjusted tension does not change due to the rotational movement of the lever.

In accordance with another embodiment of the present invention, the printer for printing on a sheet of paper has a feed opening for a first sheet of paper, a discharge opening for a first sheet of paper and a paper feeding path that allows insertion of a second sheet of paper through the discharge opening for the first sheet of paper. A stopper is provided in the paper feeding path that allows passage of a first sheet of paper fed through the feed opening for a first sheet of paper but stops a second sheet of paper by the edge of the paper fed through the discharge opening. As a result, a groove structure for positioning the bottom edge of a sheet of validation paper is not required in the paper feed path, and a leading end of a sheet of validation paper does not enter the paper feed path for transferring cut sheets of paper. As a consequence, sheets of validation paper are accurately positioned.

In a preferred embodiment, the stopper may be mounted on a common axis that mounts transfer rollers provided intermediate of the paper transfer path. Such a structure shortens the distance between a position where a second sheet of paper for validation printing is pinched by the transfer rollers provided adjacent to the discharge aperture and a position where the first sheet of paper abuts the stopper. As a result, a sheet of relatively soft paper can readily pass. Also, a sheet of paper for slip printing is transferred free of trouble in the case of slip printing.

In one embodiment, the printer has a printer upper section defining a discharge opening and a printer front section defining an insertion opening. The paper feed path of the printer is formed at least from a straight section having one end extending to the discharge opening provided in the printer upper section and a curved section connecting to the other end of the straight section and extending to the insertion opening provided in the printer front section. In a preferred embodiment, the stopper or the transfer rollers formed on the common axis of the stopper is provided adjacent to an area where the straight section connects to the curved section. As a result, a sheet of validation paper can be inserted into and transferred through a straight paper transfer path (straight path). As a result, sheets of validation paper of a variety of types can be smoothly inserted and transferred and accurately set in a printing position without paper jamming or the like.

Other features and advantages of the invention will be apparent from the following detailed description, taken in conjunction with the accompanying drawings which illustrate, by way of example, various features of embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of embodiments of the invention will be made with reference to the accompanying drawings.

FIG. 1 schematically shows a cross-sectional view of an internal structure of a printer in accordance with one embodiment of the present invention.

FIG. 2 shows a frontal perspective view of an interior structure of the printer shown in **FIG. 1** in accordance with one embodiment of the present invention.

FIG. 3 shows a perspective view of a paper transfer section of the printer shown in FIG. **1** in accordance with one embodiment of the present invention.

FIG. 4 shows a perspective view of a transfer roller drive mechanism of the printer shown in FIG. **1** for transferring cut sheets of paper in accordance with one embodiment of the present invention.

FIG. 5 shows a side view of a transfer system of the printer shown in FIG. **1** for transferring cut sheets of paper in operation in accordance with one embodiment of the present invention.

FIG. 6 shows a side view of a transfer system of the printer shown in **FIG. 1** for transferring cut sheets of paper in operation in accordance with one embodiment of the present invention.

FIG. 7 shows a side view of a validation stopper of the printer shown in **FIG. 1** in operation in accordance with one embodiment of the present invention.

FIG. 8 shows a side view of a validation stopper of the printer shown in **FIG. 1** in operation in accordance with one embodiment of the present invention.

FIG. 9 shows a side view of a conventional printer structure for positioning a sheet of validation paper.

PREFERRED EMBODIMENTS

A printer in accordance with an embodiment of the present invention will be described below in detail with reference to FIGS. **1–8**.

FIGS. **1** and **2** show an overall structure of a printer **1**. FIG. **1** schematically shows an internal structure of the printer **1**, and FIG. **2** shows a frontal perspective view of the interior of the printer **1** shown in FIG. **1**.

As shown in FIG. **1**, the printer **1** in accordance with the illustrated embodiment has a main body cover **2** that is made of, for example, a resin, a metal material or the like. The main body cover **2** of the printer **1** defines a front section **2***a* and a rear section **2***b*. A roll of paper S is disposed in the rear section **2***b* and inside the main body cover **2**. A paper transfer section **3** for transferring the rolled paper S is mounted in the front section **2***a* of the main body cover **2**.

A printing section **4** having an ink jet system for printing on the rolled paper S is disposed adjacent to the paper transfer section **3** in front of the paper transfer section **3**. The printing section **4** is covered by a main body front cover **5** that is made of a resin, a metal material or the like.

It is noted that the rolled paper S, the paper transfer section **3** and the printing section **4** are mounted on a frame **6** that is made of metal, a resin or the like.

The printing section **4** in accordance with one embodiment performs printing by using a known ink jet method. Any one of the other printing methods, such as, for example, a dot impact printing method, may also be used for printing. As shown in FIG. **2**, a guide rail **7** is fixed to the main body frame **6**, and the printing section **4** is moveably mounted on the guide rail **7** so that the printing section **4** is capable of moving between side sections **6***a* and **6***b* of the main body frame **6** along the guide rail **7**.

As shown in FIG. **1**, an ink jet head **4***a* of the printing section **4** is disposed opposite to a platen section **8** that is provided in the paper transfer section **3**.

Also, as shown in FIG. **2**, a capping apparatus **4***b* is disposed at a position adjacent to the paper transfer section **3**. When printing is not performed for a predetermined period, the printing section **4** is moved to the front of the

capping apparatus **4***b*, and a nozzle of the ink jet head **4***a* is covered by the capping apparatus **4***b*. Accordingly, when printing is not performed for an extended period of time, the nozzle of the ink jet head **4***a* is prevented from drying.

The rolled paper S is rotatably supported by a pair of support rollers **10** and **11** disposed in parallel with a roll core section **9** of the rolled paper S. A leading end of the rolled paper S is drawn from the lower side of the printer apparatus toward the upper side.

A transfer path for the rolled paper S is formed in the paper transfer section **3**. In the illustrated embodiment, the rolled paper S is guided and transferred by a paper guide section **12** and a transfer roller **13** onto the platen **3**. After printing on the rolled paper S by the printing section **4**, the rolled paper S is further transferred by a transfer roller **14** and discharged through a discharge opening **16** defined in a main body upper cover **15**. When a cut sheet of paper (described below) is not inserted, the rolled paper S can be printed.

As shown in FIG. **1**, the main body upper cover **15** is rotatably mounted about a pivot axis **17**. In order to facilitate insertion of the rolled paper S, the platen section **8** is designed to move closer to and farther from the ink jet head **4***a* in association with the open and close operation of the main body upper cover **15**. In the illustrated embodiment, the platen section **8** and the transfer roller **14** are supported on a frame **13***a* which is rotatably supported about an axis **13***b* of the transfer roller **13**. The frame **13***a* is connected to a lever **46** and is forced by a spring **13***c* mounted on the lever **46** in a direction in which the platen section **8** and the transfer roller **14** are moved away from the ink jet head **4***a*. With this mechanism, when the main body upper cover **15** is closed, a pressure lever **47** fixed to the interior of the main body upper cover **15** pushes an upper section of the lever **46**, and the platen section **8** is moved closer to the ink jet head **4***a* into a position where printing can be performed. On the other hand, when the main body upper cover **15** is opened as the rolled paper S is set in position, the pressure of the pressure lever **47** is released from the lever **46**. As a result, the platen section **8** is moved away from the ink jet head **4***a* and is placed in a receded position by the resilient force of the spring **13***c* that is mounted on the sever **46**. Consequently, the leading end of the rolled paper S is smoothly guided pass the printing section to the discharge aperture **16**.

The main body upper cover **15** and the main body front cover **5** define a discharge aperture **18** in the upper central area of the main printer body for discharging a cut sheet of paper **200** on which slip printing is performed. As described below, the discharge aperture **18** commonly serves as an insertion aperture for validation printing. A pair of transfer rollers **19** and **20** (second transfer rollers) is disposed adjacent to the discharge aperture **18**. Further, a pair of transfer rollers **21** and **22** (third transfer rollers) is disposed between the paper transfer section **3** and the printing section **4**, and a pair of transfer rollers **23** and **24** (first transfer rollers) is disposed under the printing section **4**. In embodiments of the present invention, each of the transfer rollers **19**, **20**, **21**, **22**, **23** and **24** may be composed of any appropriate number of rollers, for example, one roller, two rollers, three rollers or the like.

These transfer rollers **19**, **20**, **21**, **22**, **23** and **24**, and a pair of upper and lower guide members **25** and **26** define a paper transfer path for transferring the cut sheet of paper **200**. As shown in FIG. **2**, when slip printing is performed, a cut sheet of paper for slip printing is inserted through a paper insertion aperture section **27**.

FIGS. **3** and **4** show the paper transfer section **3** in a preferred embodiment. As shown in FIGS. **3** and **4**, the transfer rollers **13** and **14** for transferring a rolled sheet of paper S are mounted on a metal support frame **28** in the shape of a square channel. The support frame **28** is mounted on a metal transfer frame **29** that forms at least a part of the paper transfer path for cut sheets of paper. The transfer roller **13** for transferring a rolled paper S is formed from a material that is not slippery, such as, for example, rubber or the like, and has a driving shaft **30** that is coupled to a driving motor (not shown). The transfer roller **13** and the transfer roller **14** are rotated in the same direction by a gear system (not shown). The support frame **28** is rotatably mounted about the driving shaft **30** of the transfer roller **13**.

As shown in FIG. **3**, first transfer rollers **23***a* and **23***b* for transferring a cut sheet of paper are mounted on a shaft **31** that is rotatably mounted on an open/close lever **37**. Also, third transfer rollers **21***a* and **21***b* are mounted on a shaft **100** that is rotatably mounted on the transfer frame **29**.

As shown in FIG. **4**, the first transfer rollers **23***a* and **23***b* are rotated by a drive pulley **32** that is driven by a motor (not shown), a belt **33** and a follower pulley **34**. The third transfer rollers **21***a* and **21***b* are rotated by a gear **35** that is driven by the same motor (that drives the drive pulley **32**) and a gear **36** that engages the gear **35**. The open/close lever **37** is rotatably mounted on the transfer frame **29** about a shaft **32***a* having the drive pulley **32** mounted on one end of the shaft **32***a* and the gear **35** on the other end.

Referring to FIGS. **5** and **6**, a cut sheet transfer mechanism and its operation in the case of slip printing will be described. It is noted that the rolled sheet transfer mechanism shown in FIG. **1** is not shown in FIGS. **5** and **6**. It is also noted that the transfer rollers **23***a* and **23***b*, the transfer rollers **24***a* and **24***b*, the transfer rollers **21***a* and **21***b*, and the transfer rollers **22***a* and **22***b* may be simply referred to as the transfer rollers **23**, the transfer rollers **24**, the transfer rollers **21** and the transfer rollers **22**, respectively, for the simplicity of description.

The paper insertion aperture section **27** is defined by the upper and lower guide members **25** and **26** and guides a cut sheet of paper **200**. When a cut sheet of paper **200** is inserted, the transfer rollers **23***a* and **23***b* are separated from the transfer rollers **24***a* and **24***b*, and do not prevent insertion of the cut sheet of paper **200**. At this moment, a tip section **101***a* of a form stopper **101** protrudes from the lower guide member **25** into the paper transfer path by the resilient force of a spring **103**. When the cut sheet of paper **200** is inserted, the leading end of the cut sheet of paper **200** is stopped at a position corresponding to the form stopper **101**. A paper detector **102** is provided generally at the same location of the tip section **101** a of the form stopper **101**. The paper detector **102** detects insertion of the cut sheet of paper **200**.

The detector **102** also detects the trailing end of the cut sheet of paper **200**. Therefore, the detector **102** is used to determine, for example, the bottom margin of a cut sheet of paper (a printing position of the last line) that is pre-set prior to printing. As shown in FIG. **5**, when the transfer rollers **23***a* and **23***b* are separated from the transfer rollers **24***a* and **24***b*, the transfer roller **20** is brought in pressure contact with the transfer roller **19**. Therefore, the cut sheet of paper **200** cannot be inserted from the side of the discharge opening **18**.

When the cut sheet of paper **200** stops at the form stopper **101**, and the paper detector **102** detects that the sheet of paper is set in position, a controller section (not shown) activates a plunger **104** so that an iron core **104***a* of the plunger **104** moves in the direction of an arrow A, as shown

in FIG. **6**. By this operation, the paper discharging transfer roller **20** is separated from the transfer roller **19** by the operation of levers **105** and **106**. At the same time, a spring **107** pushes a pin **37***a* of the open/close lever **37**. As a result, the open/close lever **37** rotates about the shaft **32***a* in the direction of an arrow C, as shown in FIG. **6**, and the transfer rollers **23***a* and **23***b* are brought into pressure contact with the rollers **24***a* and **24***b* with the cut sheet of paper **200** being pinched between the rollers **23***a* and **23***b* and the rollers **24***a* and **24***b*. In other words, the rollers **23***a* and **23***b* are pushed against the rollers **24***a* and **24***b* by the resilient force of the spring **107**.

At this moment, the form stopper **101** rotates against the spring force of the spring **103** in association with the motion of the open/close lever **37** that rotates in the direction of the arrow C, and thus the tip section **101** a is lowered below the lower guide member **25**.

Then, the transfer rollers **23***a*, **23***b*, **24***a* and **24***b* are driven to transfer the cut sheet of paper **200** toward the ink jet head **4***a* of the printing section **4**. The rotation of the drive pulley **32** mounted on the shaft **32***b* is transferred through the belt **33** to the follower pulley **34** that is mounted on the same shaft **31** of the transfer rollers **23***a* and **23***b* so that the transfer rollers **23***a* and **23***b* are rotated. The tension of the extended belt **33** is adjusted by finely adjusting the position of an adjusting pulley **37***b* that is mounted on a portion of the open/close lever **37**. In a preferred embodiment, the tension of the belt **33** is factory-adjusted to an appropriate level.

As the cut sheet of paper **200** is advanced by the rotation of the rollers **23***a*, **23***b*, **24***a* and **24***b*, the cut sheet of paper **200** is introduced between the intermediate transfer rollers **21***a*, **21***b* and transfer rollers **22***a*, **22***b*. The intermediate transfer rollers **21***a*, **21***b* and the corresponding transfer rollers **22***a*, **22***b* are always in pressure contact with each other. Rotational force of the drive motor (not shown) is transferred through the drive shaft **32***a* and the gears **35** and **36** to the intermediate transfer rollers **21***a*, **21***b* and the rollers **22***a*, **22***b*. The cut sheet of paper **200**, that is transferred by the rollers **21***a*, **21***b* and the rollers **22***a*, **22***b*, and the rollers **23***a*, **23***b*, and the rollers **24***a*, **24***b*, is introduced between the guide member **39** and the ink jet head **4***a*, and desired characters are printed on the cut sheet of paper **200**. In a preferred embodiment, while the unshown drive motor for driving the transfer rollers is stopped, the ink jet head **4***a* is moved along the guide rail **7** to print one line of characters. Then, the transfer rollers are driven to move the cut sheet of paper **200** by a predetermined amount (for printing a next line), and then printing is performed by the ink jet head **4***a* again. These operation steps are repeated.

After the cut sheet of paper **200** has passed the area between the guide member **39** and the ink jet head **4***a*, the cut sheet of paper **200** is introduced between an open space between the discharge transfer rollers **19** and **20**.

A feeding amount from a position at which the cut sheet of paper **200** abuts the tip section **101***a* of the form stopper **101** to a position at which the cut sheet of paper **200** reaches the open space between the discharge transfer rollers **19** and **20** is pre-set by the controller section that controls the motor for driving these transfer rollers. In other words, when the cut sheet of paper **200** is transferred by the pre-set feeding amount, the cut sheet of paper **200** reaches the space between the transfer rollers **19** and **20**.

At this moment, the plunger **104** is activated so that the iron core **104***a* moves in the direction of an arrow B, as shown in FIG. **5**, to move the levers **105** and **106**. As a result, the roller **20** is brought into pressure contact with the roller **19** and the leading end of the cut sheet of paper **200** is pinched by the rollers **19** and **20**. Accordingly, the cut sheet of paper **200** can be transferred by the rollers **10** and **20**. The pressure force acting between the rollers **19** and **20** is determined by the spring **108**. When the iron core **104***a* of the plunger **104** moves in the direction of the arrow **3**, an abutting section **105***a* of the lever **105** pushes up the spring **107**. As a result, the spring **107** is released from the pin **37***a* of the lever **37**, and the resilient force of the spring **107** that acts to bring the rollers **23***a* and **23***b* in pressure contact with the rollers **24***a* and **24***b* is removed. The open/close lever **37** rotates about the shaft **32***a* in the direction of an arrow D, as shown in FIG. **5**, due to the weight of the rollers **23***a* and **23***b*.

As a result, the pressure contact between the transfer rollers **23***a* and **23***b* and transfer rollers **24***a* and **24***b* is released, and the rollers **23***a* and **23***b* are separated from the rollers **24***a* and **24***b*. In this state, the cut sheet of paper is transferred by the rotation of two pairs of the transfer rollers **119** and **20** and the transfer rollers **21** and **22**.

Also, at this moment, the spring force of the spring **103** forces the tip section **101***a* of the form stopper **101** to protrude above the lower guide member **25** into the paper feed path. However, since the spring force of the spring **103** is set to be very weak, the tip section **101***a* cannot push up the cut sheet of paper **200** and does not prevent the cut sheet of paper **200** from advancing.

As described above, when slip printing is performed on a cut sheet of paper, the cut sheet of paper is transferred by the transfer rollers **23** and **24** immediately after the cut sheet of paper is inserted. When the leading end of the cut sheet of paper has passed the transfer rollers **21** and **22**, the cut sheet of paper is transferred by two pairs of the transfer rollers **23** and **24** and the transfer rollers **21** and **22**. When the leading end of the cut sheet of paper has reached the transfer rollers **19** and **20**, the cut sheet of paper is transferred by two pairs of the transfer rollers **19** and **20** and the transfer rollers **21** and **22**. When the trailing end of the cut sheet of paper has passed the transfer rollers **21** and **22**, the cut sheet of paper is transferred only by the transfer rollers **19** and **20**.

By the paper transfer system described above, even a very short cut sheet of paper is accurately transferred when the cut sheet of paper is longer than both the distance between the rollers **23** and **24** and the rollers **21** and **22** and the distance between the rollers **21** and **22** and the rollers **19** and **20**. Furthermore, two or less pairs of the rollers pinch and transfer a cut sheet of paper during the paper transfer operation. As a result, problems that may arise in feeding cut sheets of paper are substantially eliminated. For example, wrinkles that may be formed in a sheet of paper by pinching the sheet of paper by too many rollers do not likely occur, and therefore the sheet of paper is securely and smoothly transferred.

Next, a transfer mechanism and an operation for transferring cut sheets of paper in the case of validation printing will be described below in detail. Validation printing by a printer in accordance with one embodiment of the present invention is performed in the following manner. While the transfer rollers **19** and **20** are separated, a paper slip, such as, for example, a bank check, is inserted through the discharge aperture **18** for slip printing up to an area adjacent to the transfer rollers **21** and **22**. After setting the paper slip in position, the plunger **104** is activated by a specified command or a specified key operation to bring the transfer rollers **19** and **20** in pressure contact. After the transfer rollers **19** and **20** pinch the paper slip, the printing head **4***a* is operated

to print on the paper slip, and the transfer rollers **19** and **20** are driven on demand so that the paper slip is transferred back toward the discharge aperture **18**.

When a paper slip can be inserted for validation printing, the transfer rollers **23** and **24** are closed, and therefore a slip of paper for validation printing cannot be inserted through the paper insertion aperture section **27** by mistake.

FIGS. **7** and **8** show perspective views of an area adjacent to the intermediate rollers **20** and **21**. FIG. **7** shows a state where a piece of paper **500** for validation printing is inserted, and FIG. **5** shows a state where a cut sheet of paper **200** for slip printing is inserted.

A plurality of validation stoppers **222** are rotatably mounted on the same shaft that mounts the intermediate transfer roller **22**. A spring **223** applies a relatively weak spring force to each of the validation stoppers **222** and forces each of the validation stoppers **222** in a direction in which a protruded section **222***b* of the validation stopper **222** is pushed toward a window **251** that is defined in a paper guide (for example, the upper paper guide and lower paper guide **26** and **25** of FIG. **1**), and an upper surface **222***a* of the validation stopper **222** closes the paper feed path.

When the piece of paper **500** for validation printing is inserted through the discharge aperture **18** while the rollers **19** and **20** are opened, the leading end of the piece of paper **500** abuts the upper surface **222***a* of the validation stopper **222** so that the piece of paper **500** is set in an initial position, as shown in FIG. **7**. At this moment, the leading end of the piece of paper **500** does not contact the transfer rollers **21** and **22**. Then, the plunger **104** is activated to bring the transfer rollers **20** and **19** into pressure contact, the transfer rollers **20** and **19** are driven on demand and the piece of paper **500** is printed.

On the other hand, as shown in FIG. **8**, when the cut sheet of paper **200** for slip printing is inserted through the paper insertion aperture section **27**, the leading end of the cut sheet of paper **200** passes the transfer rollers **21** and **22**, pushes up the protruded section **222***b* of the validation stopper **222**. As a result, the validation stopper **222** rotates in a direction in which the paper feed path is opened. By this operation, the cut sheet of paper for slip printing **200** can be transferred further upward. In accordance with an embodiment of the present invention, the validation stopper **222** is provided on the same shaft of the transfer roller **21** or the transfer roller **22**. This results in a shorter distance between the location where a cut sheet of paper is pinched by the transfer rollers **21** and **22** and the location where the cut sheet of paper abuts the validation stopper **222**. As a result, even a very weak sheet of paper can be readily transferred, and sheets of paper in slip printing are transferred without any problems.

In a preferred embodiment, the plunger is a self-maintained type plunger that performs pulling or returning of the iron core **104***a* by an electric current to be applied for only a predetermined period of time. As a result, power consumption by the printer is lowered.

Preferably, when the rolled paper S is printed, the transfer rollers **23** and **24** remain opened and the transfer rollers **19** and **20** remain closed. As a result, when printing on the rolled paper S, the transfer rollers **19** and **20** are closed, and therefore a cut sheet of paper for validation printing cannot be inserted in the printing section. Also, even though the transfer rollers **23** and **24** are opened, the tip section **101***a* of the form stopper **101** protrudes in the paper feed path. As a consequence, a sheet of paper for slip printing cannot be inserted in the printing section. In this manner, when printing on the rolled paper S, the paper insertion aperture section **27** and the discharge aperture **18** of the paper feed path for cut sheets of paper are closed with respect to the printing section. Therefore, a cut sheet of paper cannot be inserted by mistake while printing on the rolled paper.

In accordance with an embodiment of the present invention, the plunger is operated by specified commands or key operation to separate the rollers **19** and **20** from each other and bring the rollers **19** and **20** in pressure contact. As a result, the printing section and a part of the paper feed path for slip printing are commonly used for validation printing in which one type of cut sheet of paper is inserted for printing through the discharge aperture that is used for discharging another type of cut sheet of paper. Moreover, by using the paper feed system described above, a variety of different modes of printing operation can be provided for a variety of different modes of usage and different types of paper. Also, during a specified print mode, a sheet of paper for a different print mode cannot be inserted by mistake.

It should be noted that the present invention is not limited to the embodiment described above, and a variety of modifications are implemented.

For example, in the above-described embodiment, the description is made with reference to a printer that incorporates an ink jet type printing head. However, the present invention is not limited to this particular embodiment, and the present invention is also applicable to a printer having any one of various printing heads, such as a dot impact type printing head and the like.

Furthermore, the present invention is not limited to a printer for printing bills or bank checks, but is also applicable to other types of printers.

As described above, in a printer for printing on a sheet of paper in accordance with the above-described embodiment of the present invention, the printer has at least a pair of first transfer rollers and a pair of second transfer rollers disposed in an insertion side and in a discharging side, respectively. Open/close operation of the first transfer rollers and open/close operation of the second transfer rollers are associated with one another and performed by a single driving source. As a result, the open/close mechanism and the open/close control are simplified.

The printer includes a link movement mechanism for maintaining the second transfer rollers in a closed state when the first transfer rollers are placed in an open state by the driving source, and maintaining the first transfer rollers in a closed state when the second transfer rollers are placed in an open state. The second transfer rollers are preferably provided adjacent to a discharge aperture in the discharging side. The discharge aperture is used for discharging sheets of paper for slip printing and commonly serves as an aperture for inserting sheets of paper for validation printing. By this structure, for example, when performing slip printing, only the first rollers in the insertion side are separated from each other so that a sheet of paper for slip printing can be inserted through the insertion aperture. At this moment, the second rollers, that are disposed adjacent to the discharge aperture and that commonly serves as an aperture for inserting sheets of paper for validation, are maintained in a closed state. As a result, a sheet of paper for validation printing cannot be inserted in the printer through the discharge aperture by mistake. On the other hand, when performing validation printing, the first rollers are closed and the second rollers are opened, and thus a sheet of paper for slip printing cannot be inserted in the printer through the insertion aperture by mistake.

Furthermore, third rollers are disposed intermediate to the first rollers and the second rollers and a printing section for

printing on the sheet of paper is disposed intermediate to the second rollers and the third rollers. As a result, when a cut sheet of paper is longer than both the distance between the first rollers and the third rollers and the distance between the second rollers and the third rollers, the cut sheet of paper can be transferred through the paper transfer path, and even the entire surface of a very short sheet (cut sheet) of paper can be printed. Moreover, two or less sets of rollers normally pinch and drive a sheet of paper while the sheet of paper is transferred through the paper feed path. As a result, problems that may arise in transferring cut sheets of paper by many transfer rollers are substantially eliminated. For example, wrinkles may be formed in a sheet of paper by pinching the sheet of paper by too many rollers while the sheet of paper is transferred. Because the number of rollers for transferring a sheet of paper is substantially reduced in accordance with one embodiment of the present invention, formation of wrinkles in the sheet of paper is substantially reduced, and therefore the sheet of paper is securely and smoothly transferred.

The printer allows a sheet of paper for slip printing to be inserted from the side of the first rollers and a card-shaped sheet of paper for validation printing to be inserted from the side of the second rollers to an area adjacent to the third rollers. In accordance with one embodiment of the present invention, the printer can selectively print on a sheet of paper that is inserted in the printer from the side of the first rollers and a card-shaped sheet of paper that is inserted from the side of the second rollers.

The printer has a common aperture disposed adjacent to the second rollers for discharging a sheet of paper for slip printing and inserting a card-shaped sheet of paper for validation printing. As a result, the common aperture serves as a discharge aperture for slip printing and an insertion aperture for validation printing. Accordingly, the structure of the printer is simplified, and error insertion of sheets of paper is prevented.

The printer includes a form stopper for positioning a leading end of a sheet of paper inserted from the side of the first rollers. The form stopper is capable of projecting into and receding from a paper feeding path. The projecting and receding operation of the form stopper is performed in association with the open/close operation of the first rollers, and these operations are performed by a single driving power source. In other words, the operation of the form stopper for positioning a sheet of paper for slip printing is associated with the open/close operation of the rollers and performed by a single driving source. Accordingly, the paper feed structure is further simplified.

Furthermore, the printer has a paper feed path for transferring a sheet of paper that is provided in a roll, and a common printing section for printing on a cut sheet of paper as well as on a sheet of paper in a roll. With the structure described above, the first rollers are maintained in an open state and the second rollers are maintained in a closed state when printing on the sheet of paper in a roll. As a result, while the second rollers are closed and the first rollers are opened upon printing on the sheet of paper in a roll, the form stopper is protruded in the paper feed path. As a result, the paper feed path for cut sheets of paper is closed on the side of the first rollers and on the side of the second rollers with respect to the printing section. Accordingly, a cut sheet of paper cannot be inserted by mistake when printing on the sheet of paper in a roll.

Also, the printer has a stopper provided in the paper feeding path that allows passage of a sheet of paper for slip printing that is inserted through the insertion aperture for slip printing and stops a sheet of paper for validation printing by an edge of the sheet of paper for validation printing that is inserted through the discharge aperture for slip printing. As a result, a groove for positioning the bottom edge of a sheet of validation paper is not required in the paper feed path, and a leading end of a sheet of validation paper cannot enter the paper feed path for transferring cut sheets of paper for slip printing. As a consequence, a sheet of validation paper is accurately positioned with a relatively simple structure.

Furthermore, the stopper may be formed on a common axis that mounts transfer rollers which are provided intermediate to the paper feed path. This structure shortens the distance between a position where a sheet of paper for validation printing is pinched by the transfer rollers and a position where the leading end of the sheet of paper for validation paper abuts the stopper. As a result, a relatively weak sheet of paper for validation printing can readily pass through the paper feed path, and also, a sheet of paper for slip printing can be transferred free of troubles in the case of slip printing.

Moreover, in accordance with one embodiment of the present invention, the paper feed path is formed from a straight section and a curved section connecting to the straight section, and the stopper or the transfer roller formed on the common axis of the stopper is provided adjacent to an area where the straight section connects to the curved section. As a result, a sheet of validation paper can be inserted into and transferred through a straight paper transfer path (straight path). As a consequence, sheets of validation paper in a variety of types are smoothly inserted and accurately set in position, and transferred free of problems, such as, paper jamming or the like.

While the description above refers to particular embodiments of the present invention, it will be understood that many modifications may be made without departing from the spirit thereof. The accompanying claims are intended to cover such modifications as would fall within the true scope and spirit of the present invention.

The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims, rather than the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed is:

1. A printer for printing on a sheet of paper, the printer defining an insertion side and a discharge side and comprising:

at least a pair of first transfer rollers at the insertion side and a pair of second transfer rollers at the discharge side;

a single driving source for performing open/close operation of the first transfer rollers in association with open/close operation of the second transfer rollers; and

a link movement mechanism for always maintaining the second transfer rollers in a closed state whenever the first transfer rollers are placed in an open state by the driving source, and always maintaining the first transfer rollers in a closed state whenever the second transfer rollers are placed in an open state.

2. A printer as defined in claim **1**, further comprising a pair of third rollers disposed intermediate the first rollers and the second rollers, the pair of third rollers in continuous engagement with each other and a printing section for printing on

the sheet of paper, the printing section being disposed intermediate the second rollers and the third rollers.

3. A printer as defined in claim 2, wherein a first sheet of paper having a first shape is inserted in an area adjacent to the first rollers, a second sheet of paper having a second shape different from the first shape is inserted in an area adjacent to the second rollers to an area adjacent to the third rollers, and the printing section selectively prints on the first sheet of paper and the second sheet of paper, and further comprising a common aperture section adjacent to the second rollers for discharging the first sheet of paper and inserting the second sheet of paper.

4. A printer as defined in claim 2, further comprising:

a first aperture adjacent to the first rollers for inserting a first sheet of paper having a first shape;

a second common aperture adjacent to the second rollers for inserting a second sheet of paper having a second shape different from the first shape and discharging the first sheet of paper; and

a common printing section adjacent to the printing section for selectively printing on the first sheet of paper and the second sheet of paper.

5. A printer as defined in claim 1, further comprising a paper feed path for transferring a sheet of paper and a form stopper for positioning a leading end of a sheet of paper inserted in the insertion side adjacent to the first transfer rollers, the form stopper capable of projecting into and receding from the paper feed path, wherein the form stopper projects and recedes in association with the open/close operation of the first transfer rollers by the single driving source.

6. A printer as defined in claim 1, further comprising cut sheet feed path for transferring a cut sheet of paper, a rolled paper feed path for transferring a sheet of recording paper in a roll and a common printing section for printing on the cut sheet of paper and the sheet of recording paper provided in a roll.

7. A printer as defined in claim 6, wherein the first rollers are in an open state and the second rollers are in a closed state when printing on a sheet of recording paper provided in a roll.

8. A printer as defined in claim 1, further comprising:

a frame;

a lever defining a rotation center and rotatably mounted on the frame, and

wherein one of the pair of the first rollers and the pair of the second rollers has a fixed-side roller supported by the frame and a shifting-side roller supported by the lever, wherein the shifting-side roller comes in contact with and separates from the fixed-side roller in association with rotational movement of the lever.

9. A printer as defined in claim 8, further comprising a drive pulley provided at the rotation center of the lever, and a drive belt for coupling the drive pulley and the shifting-side roller under a tension.

10. A printer as defined in claim 9, further comprising an adjusting pulley provided on the lever for adjusting the tension of the drive belt.

11. A printer as defined in claim 1, wherein said link movement mechanism comprises:

a detector that detects the leading edge and trailing edge of a sheet of paper at a point between the first transfer rollers and the second transfer rollers;

a plunger responsive to the detector;

a first lever interconnecting the plunger and one of the second transfer rollers;

a spring mounted on the first lever; and

a second lever interconnecting the spring and one of the first transfer rollers;

whereby movement of the plunger in a first direction arranges the first transfer rollers in an open state and the second transfer rollers in a closed state and movement of the plunger in a second direction arranges the first transfer rollers in a closed state and the second transfer rollers in an open state.

12. A printer as defined in claim 1, further comprising:

a feed opening for a first sheet of paper provided at the insertion side,

a discharge opening for a first sheet of paper provided at the discharge side,

a paper feed path that allows insertion of a second sheet of paper through the discharge opening for a first sheet of paper,

a stopper provided in the paper feed path that allows passage of a first sheet of paper fed through the feed opening for a first sheet of paper but stops passage of a second sheet of paper fed through the discharge opening for a first sheet of paper.

13. A printer as defined in claim 12, further comprising:

a pair of third rollers disposed intermediate the first rollers and the second rollers, the pair of third rollers in continuous engagement with each other,

a printing section for printing on the first and the second sheet of paper, the printing section being disposed intermediate the second rollers and the third rollers, and

a common shaft mounting the stopper and either one of the pair of third rollers.

* * * * *